CHAPTER 1

Introduction

1 We were appointed in August 1965 as a standing Committee with the following terms of reference:

> To keep under continuous review the problems involved in the maintenance of buildings, including the relationship between design and maintenance; to make recommendations regarding the dissemination of existing knowledge in these fields; to identify priorities for research and development; and to make proposals for studies.

2 The circumstances of our appointment were as follows. In March 1965, the Ministry of Public Building and Works sponsored a conference on the maintenance of buildings. While particular problems had long been studied by specialists and had been discussed at local colloquia, this conference brought together representatives of the entire building team to discuss maintenance at large. It was generally agreed that the problems discussed merited systematic investigation in which the Ministry of Public Building and Works should give a lead; and our appointment followed in due course. As an earnest of the importance which the Government attached to our work the Parliamentary Secretary to the Ministry of Public Building and Works agreed to serve as Chairman.

3 It was soon apparent that we had entered one of the byways of technology. For reasons which we shall discuss later the maintenance of buildings has until fairly recently attracted little systematic study from either designers, builders or property managers; and research, which has been largely confined to the properties of materials, has not always been readily applied. This state of affairs need not continue; but it obliged us for some time to devote our resources to defining the problems before us rather than to attempting to solve them. Only after prolonged study can we begin to offer remedies with any certainty of their relevance. This seems to us a suitable stage at which to give some account of our activities, which is the purpose of this Report. We hope thereby to stimulate public interest in the maintenance of buildings and for this reason we avoid technicalities: these are developed in a companion series of monographs which are being published* on our behalf as material becomes available. A list of publications is contained in the appendix.

4 Our method of working has been initially to define two substantial areas of work for study by sub-committees consisting of persons with a particular knowledge of the subjects concerned, while we ourselves proceeded with wider problems. A *Sub-Committee on the Relationship between Design and Maintenance* was charged:

> To examine the information required by designers for the better understanding and control of maintenance in buildings and to recommend how these requirements may best be satisfied.

A *Sub-Committee on the Execution of Maintenance Work* was charged:

> To review the current practices for the execution of building maintenance as part of property management including budgetary control, and the planning and execution of maintenance work. To report to the Committee from time to time on the best practices

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**See* Appendix for details of forthcoming publications mentioned in this interim report.

in current use and to identify particular aspects where further detailed investigations should be carried out.

5 The former of these sub-committees has submitted an interim report to us and the latter has submitted a final report, on both of which we draw extensively in what follows. We are indebted to the members of the sub-committees, and of working parties appointed by them, for their assistance. No further areas of work have been identified which call for additional sub-committees on this scale: but we have isolated certain specialist subjects which can best be treated by small working groups, two of which have recently been formed with the following terms of reference respectively:

(*a*) To review the adequacy of statistical information on building maintenance as a basis for decision taking by government, individual firms, organisations and authorities; and to recommend any necessary improvements, having regard to resources available for collection, analysis and dissemination of the relevant data.

(*b*) To consider whether there is evidence that tax regulations affect decisions on the balance between capital expenditure and subsequent maintenance expenditure on buildings, and if so to examine the practical effects.

6 Technical support for our work is the duty of the Committee secretariat in the first instance. A number of topics, however, require research facilities beyond the immediate resources of the secretariat, and in these cases the Ministry of Public Building and Works has commissioned studies by academic and other bodies on our behalf. Contributions from these studies are being published in the series of technical monographs.

CHAPTER 2

The Role of the Committee

7 Building maintenance is a major activity in most countries. We estimate that in the United Kingdom it currently accounts for expenditure of some £1,550 million, of which about £360 million is incurred by industry and commerce using their own labour and by householders providing their own labour free. The remaining £1,190 million is distributed between contractors (£750 million) and public authorities (£440 million) and accounts for a quarter of all expenditure on construction and two fifths of the construction labour force. This expenditure of £1,190 million is analysed graphically by function and by type of work in Figures 1 and 2, and the maintenance labour force of 585,000 persons is analysed in Figure 3.

8 It follows that any significant improvement in the deployment of these resources will have a discernible effect on the national economy. As a crude illustration, the effect of saving 10% of annual maintenance expenditure and of the maintenance labour force would release over £100 million per year and the labour of nearly 60,000 workers. In practice, however, the sums are more complex. It has been calculated that arrears of housing maintenance in this country may amount to eight or nine times the volume of work actually carried out each year: and although firm evidence is lacking for other sorts of building the signs of their neglect are around us. Any resources that can properly be released from existing maintenance commitments might well go towards making good these arrears, which account for the premature decay of much of the built environment. Moreover, buildings are growing in complexity and increasing in number while the supply of workers to maintain them tends if anything to decline; and the output of these workers, unlike those engaged on new construction, does not appear to be rising. The supply of maintenance workers may well diminish further, or become very expensive, as conditions of living and working improve. Savings in manpower are therefore necessary simply to retain existing standards of maintenance.

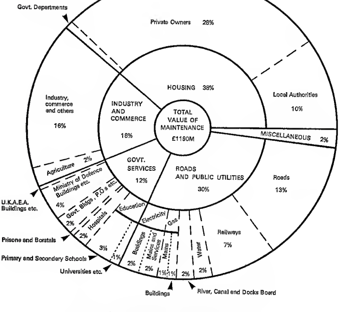
9 For these reasons our objective is not simply to reduce the volume of expenditure on building maintenance, convenient as this may be as a general slogan. Nor, at the other extreme, can we entirely adopt as a working rule the British Standard definition of maintenance, which is 'Work undertaken in order to keep or restore every facility, i.e., every part of a site, building and contents, to an acceptable standard'. We see no early prospect of restoring, let alone keeping, a majority of buildings to a standard which is acceptable. Our objective is rather that, even if the resources available for construction generally cannot quickly be increased, nevertheless the distribution of those resources as between new works and maintenance, and their deployment within maintenance, should be determined in the way most advantageous both to the economy as a whole and to individual estates of every size within it.

10 As one might expect, we have found that the obstacles to this optimum allocation of resources are stratified. Some may in principle be removed at the stroke of a pen: it is, for example, not difficult to think of changes in tax regulations or contractual conditions which would, other things being equal, have a marked influence on the distribution of resources between maintenance and new works. Obstacles of this kind lend themselves to deliberation in committee, even if their removal would entail institutional changes on a national scale: we discuss a number of such changes later. Other

obstacles may require expenditure of time and money to resolve. Some problems of materials or of equipment or of industrial organisation may be of this category. Here we can recommend the direction and form which studies should take, but must then await the results. Finally there are obstacles born of indifference or ignorance which call chiefly for enlightenment. Plenty of maintenance practice is just poor value and reflects a want of education at all levels more than a want of research. Committees, of course, cannot educate other than by reports such as this, but members of the Committee and its secretariat take opportunities open to them of publicising sensible practice. There is indeed evidence of a developing public interest in maintenance questions, which may probably be traced to the widespread interest in sound management generally: professional seminars pay increasing attention to maintenance, industrial conferences on the subject attract a wide audience, and a magazine concerned solely with building maintenance has recently been launched.

11 Maintenance in fact is not a single activity. It is a system of inter-related activities on the part of different agents: of society itself, of

Fig. 1 ESTIMATED PERCENTAGE EXPENDITURE ON CONSTRUCTION MAINTENANCE IN 1967
(Analysis by function)



Note: All figures taken to the nearest whole percent.

(The basis of the collection of figures is such that they include Minor New Works)

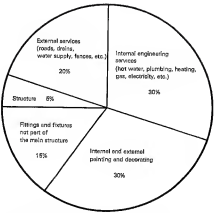


Fig. 2 FINANCIAL BREAKDOWN OF MAINTENANCE EXPENDITURE BY TYPE OF WORK
(Total expenditure £1,190m.)

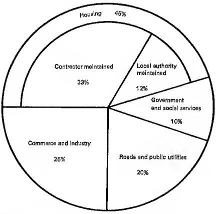


Fig. 3 DISTRIBUTION OF THE LABOUR EMPLOYED ON MAINTENANCE
(Total labour 585,000.)

government, of designers, builders and property managers. Each have their own ideas of good practice and contribute their own obstacles to its fulfilment. Therefore rather than study maintenance as a series of events in the life of a structure, we have found it better to examine first the social environment in which maintenance occurs; then why it occurs; then what to do about it; and only finally to examine how to do what needs to be done.

Any analysis of the maintenance system must be arbitrary in part, but our approach has the advantage of emphasising that acts of maintenance occur only on account of other acts and omissions, which must be understood in their context and perhaps adjusted before one necessarily admits that maintenance is required at all. Each of our four areas of analysis occupies one of the following chapters.

CHAPTER 3

The Context of Maintenance

12 In this chapter we consider the attitude of the community to maintenance with a view to identifying the social obstacles to better practice and suggesting means of adjustment. We doubt if it is fortuitous that building maintenance retains a lowly status in many budgets of human and other resources: but we also doubt if much improvement in practice can be expected without some improvement in status. Ways must therefore be found of increasing general awareness of maintenance and its problems. We recognise, of course, that more reputations will always be made—or lost—in the design of buildings than in their preservation. There are aesthetic reasons for this and we do not quarrel with them. Buildings, however, are not only less glamorous to maintain than to design or construct, but the effect of maintenance is also less noticeable. It is therefore possible to neglect maintenance for prolonged periods with only a marginal effect on efficiency. The tendency is therefore often to prefer other forms of expenditure and to allow buildings to join other durables in a class where repairs rank as distress purchases, to be avoided where possible and perhaps resented. Maintenance therefore enjoys a somewhat hostile environment.

13 Research has yet to be undertaken which will show conclusively how far this hostility is rational. In the broadest terms we believe that decay is usually a poor bargain at any price: but it is possible to argue in narrowly economic terms that maintenance is justifiable only to the extent that its marginal contribution to the economy of the country or of the individual organisation exceeds that of any alternative use of the resources employed. We know of no systematic study of the economic significance of maintenance which would enable the importance of this argument to be evaluated. Such a study would necessarily be a longer term exercise than we have yet undertaken, but we recommend that it should be given early consideration for the programme of construction research sponsored by the Ministry of Public Building and Works.

14 As a preliminary to a study of this kind we have looked in some detail at the status of maintenance statistics which are currently available. In the main these are prepared by the Ministry of Public Building and Works, but there are a number of exceptions. This in itself raises doubts about the uniformity of the data. Moreover, there is a major distinction to be drawn between data collected from contractors and from local authorities, respectively: the former value output in terms of prices obtained, whereas the latter, in the absence of a normally competitive market, value it in terms of costs incurred. One must further allow that contract prices reflect the vagaries of tendering and that costs incurred vary with the manner of computing overheads, quite apart from other cost factors. It is therefore obvious that for proper but not necessarily insuperable reasons maintenance statistics, like some other construction statistics, are less than adequate for detailed analysis. Attempts to correlate relative productivity, costs, etc., to different periods or different sectors of the industry are correspondingly vitiated. We have therefore referred the whole question of maintenance statistics to a working group whose terms of reference are set out in our first chapter. The group is well aware that any proposals which it may make for changes of practice must have regard to the statistical burden which already falls upon the construction industry.

15 Apart from the collection of statistics Government takes formal note of maintenance in one further respect. Subject to certain provisos, expenses incurred in property maintenance are allowable against liability for tax. The significance of this relief was effectively terminated for the ordinary owner occupier with the abolition of his liabilty for tax under Schedule A, but relief remains of importance to corporate and other property owners. On the whole its effect is to reduce the cost to the property owner of a given volume of maintenance work relative to the corresponding volume of new work, which in most circumstances attracts less relief by way of investment grants and depreciation allowances, particularly in the case of commercial buildings. The explanation of this apparent anomaly may simply be that capital expenditure is provided from funds which are not normally subject to income or corporation tax and are therefore not susceptible of direct relief: but we are not satisfied that the effect is necessarily advantageous to the property concerned. Since in the short term it usually appears cheaper to do no maintenance at all, relief does not directly stimulate expenditure upon it: whereas absence of relief directly discourages maintenance-saving investment. It is therefore possible that the tax system disturbs the natural balance between maintenance and capital expenditure, which tends to be the more efficient of the two in terms of productivity. How far commercial practice is actually influenced by this apparent discrimination is not known, and the objective of the second of our working groups already mentioned is to find out. Clearly any recommendations which may result will have to be considered in the light of broader fiscal strategy.

16 Otherwise statute law takes little account of maintenance beyond the normal requirements of public health and safety. Owners and tenants may make such arrangements for maintenance as they see fit, subject to a provision of the Housing Act, 1961, which limits the extent to which a tenant may be made responsible for repairs to a dwelling house. It has come to our attention that to an increasing extent tenants of commercial and industrial buildings, even of those in multiple occupation, are being required to assume liability for structural maintenance and repairs. The purpose of these arrangements is usually to reduce the risk element of inflation in predicting the allowance in rentals to be set aside for maintenance, rather than necessarily to influence the physical arrangements for undertaking the work, which indeed the landlord may still undertake at a negotiable fee. But we have misgivings lest knowledge of a building and its needs may thereby be dissipated from its original owner among a succession of tenants. We have in mind to study this question further to see what effect tenure may have on maintenance practice.

17 So much for the legal framework of maintenance. We come now to an area in which Government policy is no less effective for want of statutory backing. In recent years there has been substantial progress in the public sector, and to a lesser extent elsewhere, in the application of systematic cost control to new construction. Precise terminology varies, depending whether cost limits or cost yardsticks apply, but the principle is to determine in advance of commencing design a sum of money per unit of accommodation which is not to be exceeded without authority. The designer is then allowed scope for initiative within the ceiling, the cost of the building programme is kept within bounds, and with the delegation of approval to all but exceptional cases the burden of management is reduced. We would not detract from the advantages which accrue where cost control is properly applied. As now applied, however, such control relates primarily to capital cost: yet over the life of a building the capitalised value of maintenance and running costs may, particularly in the case of engineering services, exceed the original capital expenditure. A competent designer will naturally take running costs into account in his calculations, but in the absence of any formal requirement to do so there may sometimes be pressures towards reducing capital expenditure here and there to achieve a cost limit at the expense of heavier expenditure later. Admittedly a correct balance is easier to achieve in the case of engineering services, where the relevant calculations are fairly straightforward, than with the building fabric, for which estimates of maintenance costs may not be readily forthcoming. Nevertheless, we believe the problem to be sufficiently important to merit effort to provide more guidance than is so far available on the relative weight to be given to capital and running costs in buildings which are constructed to cost limits. We recommend that the Ministry of Public Building and Works should seek to develop solutions to the problem in collaboration with other Departments. We refer later to the data and methods of computation which may be relevant to exercises of this kind.

18 Some general comments on vocational training are also appropriate to this chapter. We shall see later that the training of those who actually undertake maintenance work leaves something to be desired, which is itself a reflection on the status of the subject. We

draw attention here, however, to a number of disciplines which affect the need for maintenance more than may be realised, but whose curricula pay it little attention. Designers of buildings and of building components determine many of the maintenance characteristics of those buildings, and often reveal their ignorance in doing so: the elementary oversight of safe access is disturbingly common. Other members of the design team such as quantity surveyors have particular responsibility for advice on costs, and are liable to underestimate the importance of cost in use relative to initial cost. Site control of new building works usually pays closer attention to soundness of technique than to scientific quality control. Finally, management of property tends often to vest either in persons who are skilled in the commercial or social aspects of property, or who, particularly in industrial establishments, are primarily engineers. Neither category is necessarily versed in building maintenance as such. A fair degree of knowledge may, of course, be picked up: but it is right to add that, so far as a science of maintenance may be said to exist, it calls for some intellectual rigour. Indeed it provides a fruitful though under-exploited area for the application of systems analysis and operational research. For maintenance to take its proper place in academic and professional syllabuses therefore implies no dilution of their content.

19 Training for maintenance has been the subject of a special report to us from our Sub-Committee on the Execution of Maintenance Work, and a number of bodies with educational responsibilities towards the construction industry have had an opportunity of commenting upon the report. We welcome the sympathetic reception which it has generally obtained and are considering with some of these bodies what adjustments to their syllabuses would most advance the practice and academic standing of maintenance. The subject is peripheral to many courses of study but central to few, and in consequence has few specialists. We are particularly concerned that maintenance management, as understood either by the property owner or by the building contractor, is so often the responsibility of persons with little specific training for it. We therefore recommend that the Construction Industry Training Board should be encouraged to enlist the support of the industry in developing building maintenance as a branch of management in its own right. Where maintenance personnel are outside the scope of the Board it is desirable that reciprocal arrangements for this training should be made with the appropriate authority.

CHAPTER 4

The Causes of Maintenance

20 Few structures are wholly maintenance-free. This is not to deny the survival of some remarkable monuments to bygone methods and materials; but even these usually prove to require periodical inspection and adjustment. Some of the conventional load-bearing materials give rise to very little maintenance over the economic life of the building which they support: but finishes and services mostly require attention from time to time. It is sometimes suggested that only the cost of achieving complete freedom from maintenance prohibits it. In our experience, however, the materials and methods do not yet exist which will give a building absolute protection from the attacks of climate, movement, use and abuse, or biological and chemical agents. The degree of maintenance necessary does of course vary and reflects both the relative severity of attack and the quality of the original design and construction. Reduction in the incidence of specific forms of attack is the subject of research elsewhere, and in this chapter we concentrate on the part played by original design and construction.

21 We begin by considering how far existing practice is conducive to maintenance carrying proper weight with designers and contractors. Demand on resources is such that there is usually pressure on both of these parties to keep initial cost to a minimum consistent with standards in which maintenance costs are not always the deciding factor. In the case of the contractor this pressure is formally acknowledged by the conventional method of competing for work on price. There is not much countervailing pressure toward economy of maintenance beyond the slow percolation of mistrust where high running costs are unexpectedly incurred. The maximum period of contractual liability of designer or contractor for new works seldom exceeds twelve months from date of completion and is frequently less. We have therefore considered whether longer periods of liability, such as prevail in some Continental countries, would secure reductions in maintenance costs without, of course, being entirely offset by the risk premia which might be charged by designers, contractors or their respective insurers. Some further study of the time profile of component failures and of the social environment of Continental practice is desirable before reaching a firm conclusion about the value of such a change. We are, however, encouraged by experience of other industries and of the ten year guarantee of the National House Builders' Registration Council to be optimistic that longer periods of liability might achieve real savings in cost and convenience simply by enhancing the inducements towards proper forethought and inspection. We would expect also that consequential pressure would come upon component manufacturers to give more substantial guarantees of their products than is usual at the moment. Indeed the whole subject of liability in the construction industry merits exploration by the numerous interests concerned. We look to the Government to give a lead in consultations to determine the optimum arrangements in respect of its own contracts.

22 In return there is some obligation to provide better access to information about the properties and performance of materials and components so that decisions affecting the life of a building may be rationally based. In saying this we recognise that much research on materials is undertaken at government and

other establishments of which the results are made generally known: and that the work of the Agrément Board and of the Construction Industry Research and Information Association will, as it develops, facilitate the task of the building team. But there are a number of gaps in the study of maintenance technology, some of which were discussed at a conference of specialists held under the auspices in April 1968 at the Bath University of Technology. The proceedings of the conference are to be published and provide evidence of the scope for further studies which we understand the Ministry of Public Building and Works is to co-ordinate and, where necessary, support. In addition, however, there is a dearth of reliable information about the performance of components in the field as opposed to laboratory conditions. Field studies of buildings in use are notoriously slow and inconvenient to the occupants, and tend therefore to be neglected; whereas they can be of the greatest value as a source of feedback to designers. With our encouragement the Ministry of Public Building and Works is embarking on a prolonged study of the maintenance characteristics of selected building components in conjunction with a large number of universities and colleges which possess architectural departments. We expect thereby to achieve not only results which are directly usable but also a greater awareness of maintenance in academic establishments.

23 There is the further problem that technical services for the building team are not readily accessible on a local scale. Routine testing of components against specification is undertaken by a variety of commercial and other laboratories. But there are few regular laboratory or advisory services such as, for example, the design and supervisory staff of the Greater London Council receive from the Scientific Adviser to the Council, whose bulletins on building materials are a model of their kind. Where it exists, such a service is invaluable in resolving technical problems ad hoc as they arise in all stages of the building cycle, whether during design, construction, or subsequent maintenance. There is at present scope for a service on a national scale which might even include the Agrément Board and the Construction Industry Research and Information Association among its sponsors or customers. We judge that the commercial prospects of a national testing and advisory service for ordinary building components are sufficiently promising to merit detailed study by the Government.

24 There remains one further source of information about building components which is as yet almost untapped. The records of maintenance organisations contain a wealth of data which, if it could once be codified, would yield information of substantial value to designers and maintenance managers alike. Codification would both entail and encourage the adoption of one or more uniform recording systems which offer many advantages over the haphazard methods commonly in use. Some study of the data available has already been undertaken on our behalf by Bath University of Technology with a view to establishing its nature and quality, and we are satisfied that the potentialities of the material should no longer be ignored. The Ministry of Public Building and Works has therefore commissioned the University to prepare a detailed report on the feasibility of introducing a Maintenance Cost Information Service based on the data available from prospective subscribers, and generally comparable to other schemes for sharing information. We recommend that in the event of a favourable report the Government should give early consideration to arrangements for implementing it.

25 We must, however, enter a major caveat to the indiscriminate use of maintenance cost data, however reliable. There is no point in imposing yet another constraint upon design unless it is understood that this particular constraint has a precise economic function. It is insufficient merely to note that certain components appear to have a long or short expectation of life and should therefore be filed for use or avoidance as the case may be. It has become generally recognised that income and expenditure at different points in time can be properly aggregated and compared only by discounting at a common rate of interest. Investment has therefore come to be evaluated by financial advisers in terms of the discounted cash flow arising from the investment, in preference to longer-established but less reliable methods of appraisal. Design decisions in construction have, however, tended to escape the rigours of the new approach, probably because the data necessary to the relevant calculations appeared to be lacking as regards either building components or the rates of interest appropriate to real estate. Sufficient work has in fact been done to show that accurate data are not always critical to the discounting exercise, which is remarkably effective in revealing to the designer where his margins of error may lie. It has also been shown conclusively that the exercise upsets—and in other cases confirms—a number of traditional ideas about economy of design. We regard construction as an area of investment which has yet to come fully to terms with modern methods of financial

appraisal, and we therefore support the proposal of the Ministry of Public Building and Works to publish some guidance to designers and maintenance managers on the use of discounting techniques. What the Ministry cannot, of course, do is to offer advice about specific discounting rates, since these vary from time to time and with circumstances. Choice of discounting rate is the prerogative of investment managers and the designer is entitled to ask them to exercise it.

26 We have said sufficient to show that no member of the building team can opt out of responsibility for the maintenance characteristics of the finished building. It is easy enough to argue that detailed calculation of initial and running costs is a matter for the quantity surveyor and services engineer; but unless client and architect and contractor are themselves aware of the field of economic choice open to them they will not formulate the right problems for the specialist to solve. No doubt economic forces will themselves bring about this awareness, given time, but the process can be accelerated and systematised by a change of emphasis in vocational training which we believe to be overdue. The subject of building economics does not appear to us so far to have achieved a rigour of treatment in professional syllabuses commensurate with other more traditional subjects or with its own importance. The sooner it does so the better for the avoidance of waste in building design.

CHAPTER 5

The Management of Maintenance

27 We have already acknowledged that buildings can never be maintenance-free. It follows that maintenance must always be someone's responsibility. To ignore this simple truth is to court heavier bills in the long run: our purpose in this chapter is therefore to emphasise it. Every property owner from the largest institutional estate to the least houseowner has the opportunity to exercise good management by attending to rules which are basically simple.

28 Perhaps the most obvious and universal rule is to seek the advice of the original building team wherever this is available. Naturally it will seldom be available for older buildings, but these are usually of simpler construction than more modern ones and have had time to evolve a maintenance routine of which the merits or demerits should be visible. More recent designers and builders are usually still available to interpret their original intentions for the maintenance of their buildings, and it has for some time been quite common for the purchaser of a new house to receive with it sufficient literature to provide basic guidance in its upkeep. In principle, similar facilities are open to purchasers of other buildings, although in practice little is usually offered beyond a set of drawings and such information as engineering firms may volunteer about services. The reason for excluding more general information is probably that the cost of providing it appears to outweigh its usefulness to experienced management. This argument, however, tends to underestimate the rate at which experience is currently being overtaken by innovation in construction techniques. As an experiment we therefore asked the Ministry of Public Building and Works to commission the preparation of a maintenance manual for a recent Crown building and to invite the comments of selected maintenance organisations upon it. We conclude from the response that there would be a good market for a simple manual prepared as one of the concluding tasks of a design commission. The Ministry has in mind to publish guidance on the form of such manuals in consultation with the professional institutions.

29 The smaller property owner, of whom the houseowner is typical, has few other rules to follow. Preventive maintenance is for him a matter of regular inspection and decoration, both of which are tasks which he tends increasingly to undertake himself. Where work is put out to contractors the degree of satisfaction varies considerably and we have considered in some detail why this should be. The industry itself acknowledges that the small builder has an indifferent public image and is concerned to improve it.

30 We doubt if it is sufficient explanation to cite the general dislike of incurring maintenance expenditure, which we have already mentioned. We recognise, however, that lack of funds must obviously aggravate relations between client and contractor, and we should welcome further endeavours on the part of the industry to provide its customers with information about access to credit. This is only one aspect of a general marketing approach to maintenance which the industry might do well to develop. We would expect a marketing strategy to relieve the difficulties which some clients encounter in securing a reliable contractor or communicating their requirements. It ought also to improve relations between client and contractor subsequent to the completion of work. Other industries have succeeded in

similar objectives to the advantage of all concerned. The status and requirements of the small maintenance client is, however, a subject of sufficient importance to the community at large to merit some further objective study. We have therefore encouraged the Ministry of Public Building and Works to collaborate with other interested bodies in a survey of householders and the maintenance facilities open to them with a view to identifying the scope for better service to the least organised sector of the maintenance market.

31 The larger property owner is in a much stronger position but often fails to exploit it. There is no reason why his maintenance requirements should not be organised on a business footing with a sound management structure, clear objectives and a rational budget. In practice, however, other departments of the organisation tend to take priority in the allocation of total resources on the ground that they determine the viability of the organisation more effectively than maintenance can do. Thus maintenance often becomes a subsidiary function of, say, the commercial or production department; it then inevitably reflects the immediate objectives and financial stresses of these departments. Policies of this kind are in our view self-defeating: they expose a major asset of the organisation to unnecessary risk and give rise to uneconomic methods of operation. We are therefore strongly in favour of defining the status of property maintenance within the organisation and thereafter managing it as a separate activity with an established policy. Managerial techniques of resource allocation are available for determining the appropriate status in particular cases.

32 The maintenance manager can then apply standard principles of operation in the knowledge that the ground rules for his decisions are not liable to arbitrary change. He can decide questions of preventive maintenance or of repair versus replacement without the risk of the financial basis of his calculations being suddenly upset. He can compare the cost of contract and directly employed labour and assess their respective merits in his particular circumstances. But it is no use his doing so unless he can obtain access to accurate information about the working of the organisation at large and knows how to interpret the information once he has it. For instance, the value of preventive maintenance to a production department is determined by the risk and cost of breakdown relative to the cost of prevention. Values for each factor must be calculated before decisions on maintenance policy can be taken. In an office, on the other hand, staff amenity may be more significant than the possibility of breakdown. Maintenance policy must then be so formulated as to bring out the price which is to be paid for amenity.

33 We doubt very much whether maintenance management generally is yet accustomed to handling information of this kind and taking decisions upon it. The Ministry of Public Building and Works is therefore promoting the development of fundamental decision rules and models for determining maintenance policy on a scientific basis. The Ministry has also made case studies of maintenance organisations selected, in the main, for their apparent effectiveness; these too will be published to facilitate comparisons and changes of practice. It is further to be hoped that the study for a Maintenance Cost Information Service will yield a practical means of bringing together the experience of maintenance organisations with a view to stimulating good practice.

34 The potential scope for improvement in property management goes well beyond our immediate resources. We envisage that with proper encouragement, public interest in sound practice and new techniques would be sufficient to support a permanent centre of study drawing upon a variety of disciplines including operational research. We would expect such work to make most progress in a research institute associated with established academic bodies and we suggest that the operational aspects of property management might profitably be considered for study in such a centre in due course. We suggest further topics for the same or another centre in the following chapter.

CHAPTER 6

The Execution of Maintenance

35 So far we have spoken of maintenance largely as a branch of design, construction and management. It remains to discuss maintenance in the more familiar terms of work to be done. By delaying discussion of this aspect we do not underrate its importance; indeed it is the direct occasion of our appointment. But it is our contention that many defects of execution are attributable to avoidable defects elsewhere in the maintenance system. Having suggested remedies for some of these we can now consider the execution of maintenance apart from extraneous hindrances.

36 It is important first to remember that building maintenance is not a single industry. Many principles of operation are of course common to all sectors of maintenance. But an important distinction is to be drawn between maintenance undertaken by contractors for profit and that undertaken by commercial enterprises and public authorities as an adjunct to other functions. Contractors in fact account for less than half of all estimated expenditure on building maintenance: nevertheless they constitute the more flexible part of the maintenance business in that they are subject to direct economic pressures and can respond fairly readily to changes in the pattern of demand. In these respects they differ somewhat from bodies which meet their own maintenance requirements in whole or in part and accept a certain rigidity in consequence. The absence of an immediate profit motive in maintenance organisations of this type entails the substitution of other forms of motivation and objective. It is important that these should be defined by management although it may not be easy to do so. It is also important to recognise that they may lack the force of the profit motive and are not necessarily amenable to the same sanctions or inducements.

37 An example may make the distinction clear. We have naturally sought to study the productivity of maintenance labour with a view to identifying means of improvement. Output of maintenance work is notoriously difficult to measure because so many individual maintenance tasks are impracticable to define. But we do not accept that a discernible measure of improvement need await precise assessment of individual tasks. The Ministry of Public Building and Works therefore commissioned on our behalf two studies of the use of labour incentive schemes, the first among small builders who account for most maintenance undertaken by contractors, and the second among local authorities. These are descriptive but critical studies which the Ministry proposes to publish. They bring to light a variety of incentives which have been tried with varying degrees of success. As one might expect, among small builders attitudes to incentive schemes are largely determined by the supposed effect on output and financial viability. This effect is not always assessed as accurately as it should be but is in principle definable. Among local authorities, on the other hand, such schemes are measured against other criteria. There is usually some attempt to show that the cost of managing the schemes is less than the direct savings achieved: but records are usually inadequate to show how authentic these apparent savings are. Because there is no commercial interchange between client and agent departments there is no way of establishing accurately how much work went unrecorded before the introduction of an incentive scheme provided the motive to record it. Local authorities therefore lay greater emphasis either on the arrears

of maintenance which their incentive scheme has enabled them to clear; or the faster response rate to requests for service; or the retention of an adequate labour force owing to the improvement in earnings. These are not improper objectives: but management must determine how much it is prepared to pay for them and stand by its decision. A high speed of response is a particular example of a service which may be unjustifiably expensive to provide.

38 In our opinion the use of labour incentives in building maintenance is justifiable to the extent that they can be shown to further other admissible objectives. Subject to this proviso we believe they are capable of wider use than has been attempted hitherto. So far as schemes based on work study are concerned, a practical obstacle to their use by small organisations is the lack of reliable measurement data. This can only be remedied by the development of work study data banks for the construction industry as a whole. We see this as a fruitful area for collaboration between employers and workers which the Government might usefully encourage. In the longer term we would hope that work study might, where appropriate, give way to less mechanical methods of assessment as the industry develops confidence in the necessary management techniques. Maintenance tasks call particularly for skilled operatives capable of working under a minimum of supervision or support from other trades, who will justify a substantial reward in return for sustained and reliable output. Undue regulation may defeat the purpose of employing them.

39 It is unfortunately true that the genuine maintenance craftsman is scarce. The absence of the stresses and incentives of new construction tends to attract the older or unskilled worker who is prepared to accept lower remuneration in return for lower tempo. The Construction Industry Training Board is endeavouring to remedy want of skill by means of conversion and other courses for recruits to maintenance, but in so large an industry the Board's rate of influence is necessarily gradual. Maintenance organisations would therefore be well advised to review the effectiveness of their existing labour force and make the most of it. To do so they must draw far more than at present on techniques which have proved their value in production engineering and whose objective is the elimination of waste.

40 Some of these techniques can be applied without undue tailoring to maintenance practice. The principles of management accounting are, for instance, applicable to almost any enterprise but are notably lacking among smaller builders, whose indifferent financial standing is a national problem. The principles of stock control are also universal and are insufficiently applied. In the nature of maintenance work materials tend to be required in small quantities and it is for assessment how far to depend on wholesalers to carry stocks and in what quantities to draw off to stock and from stock to site. Excessive stocks tie up scarce capital and inadequate stocks lead to idle time: small contractors are particularly sensitive to the former danger owing to scarcity of working capital and may therefore tend to underestimate the latter. A balanced use of resources therefore calls for timely ordering of materials.

41 The amount of equipment necessary to any but the largest of maintenance organisations is not great. The work does not generally lend itself to capital-intensive methods, and major items of plant can in any case readily be hired. There are, however, a number of minor power tools on the market which have not yet entirely overcome the resistance of some managements and operatives: the former need persuading of their economic value and the latter need training in their use. It may be also that there are gaps in the range of tools available. With this in mind the Ministry of Public Building and Works is arranging studies of the types of building defect commonly encountered in maintenance work with a view to developing a wider range of tools and better methods of working.

42 There are other production techniques which require extensive adaptation for use in building maintenance. The location of depots relative to the field of work, the use of mobile workshops, production scheduling and manpower planning are all susceptible of objective study granted adequate knowledge of the estates to be managed or the business available. The changes to which such studies may lead require a particular understanding of industrial relations in the industry. The Ministry of Public Building and Works has made studies of the solutions, sound and less sound, which particular organisations in the industry have evolved for these problems, and will be publishing the results. We doubt, however, if it is sufficient to rely on the slow permeation of good practice to bring about changes in the execution of maintenance on a wide scale. We believe that the more effective method is to make provision both for sustained research into managerial and operational problems such as we have discussed, and for applying the fruits of this research. Such studies might well

begin by examining the structure of the maintenance market and the prospects for enlarging individual orders into units of demand large enough to take advantage of economical methods of production, and hence to release the forces of competition which are latent in the maintenance industry. It seems to us that undue fragmentation of demand impedes investment in modern equipment and promotes a scale of operation too small for effective competition.

43 We envisage research in this field as parallel to the study of property management which we recommend in the previous chapter, though not necessarily a task for the same centre of research. Application of techniques developed from these studies may be ensured by encouraging the research workers to undertake consultancy work. It may not be a commercial proposition to provide a consultancy service to the smaller maintenance organisation. In this part of the market it may be preferable to develop a standard management service, based on the hire of computer time and providing facilities for accounting, stock control and product scheduling. Services of this kind are developing in other industries.

CHAPTER 7

Summary and Conclusions

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44 Our appointment marked the commitment by the Government to undertake systematic study of a neglected but significant area of technology. The price of building maintenance is heavy in resources of men and money: the price of neglecting it is paid in decay. Arbitrary changes in the volume of these resources can only aggravate one or other of these burdens. We see our task as obtaining better value from the resources already employed.

45 The obstacles to our doing so are scattered about the building process. Some lie with society, some with the designer; some with property owners and others with the maintenance trade itself. Reform may call for enlightenment, for research or for sanctions. In this Report we have reviewed the principal obstacles known to us and suggested some means of alleviation.

46 We suggest first that society itself should make up its mind what priority to accord to building maintenance. To this end we have appointed working groups to examine the availability of maintenance statistics and the significance towards maintenance of taxation. We also have under review the consequences of different forms of property tenure and the working of capital cost control in the public sector. Training for maintenance has been the subject of a sub-committee report to us which we are seeking to implement in collaboration with the responsible authorities.

47 We then consider the influence of the building team on the maintenance characteristics of new construction. Contractual liability for these characteristics seldom extends long beyond physical completion and it is for further study whether more prolonged liability would be generally advantageous. Better access to source data for the calculation of maintenance characteristics is necessary if the building team is to anticipate them; and assessment of their financial implications entails the use of discounting techniques to bring expenditure at different times on to a common basis. Practical arrangements are in band for assisting the building team in these respects.

48 In turn the property owner must be encouraged to seek the guidance of the building team wherever practicable. For this purpose we advocate the preparation of a maintenance manual as part of the normal design commission. The smaller owner may be ignorant of maintenance and its execution, and would benefit from the development of marketing techniques among maintenance contractors. His relations with the trade are to be studied in greater detail. The larger property owner may not always accord to maintenance the access to managerial or financial resources which its importance would justify. Maintenance is actually a promising area for exploiting operational techniques derived from production engineering. Information about these techniques and examples of successful application are to be made available. The potential field of development warrants sustained research.

49 Maintenance tasks are undertaken either by contractors for profit or by directly employed labour in the course of estate management. When there is no immediate profit motive particular care is needed in the efficient use of resources. We call attention to the motivation of labour under these conditions

and look to the industry at large to review the measurement of maintenance output and the application of labour incentive schemes based upon it. Pending a better supply of skilled maintenance workers, improvements in efficiency largely depend on management. We note for publication of further guidance the topics of stock control, equipment, method study, and production scheduling and control. The maintenance market is in need of development to achieve economic production under adequate competition. Here again there is scope for sustained research, accompanied by development in the field.

50 It is apparent from this summary that our work is not yet complete. Building maintenance is not a single branch of learning capable of definitive study, even if the source material were readily forthcoming. It is a mongrel science of varied ancestry: part architecture, part physical chemistry, part management, and so on. As such it is not yet entirely respectable. We see as our greatest task the education of opinion to accept that building maintenance is entitled to professional status equal with building design or construction. This objective requires that all members of the construction industry should be constrained to make full use of the knowledge of building maintenance which already exists; and that the frontiers of this knowledge should penetrate much further yet. We do not expect to see bad practice eradicated. Good practice, however, will spread if designers and builders learn to plan ahead for maintenance, if maintenance managers secure responsibilities commensurate with the resources in their charge, and if labour is organised for efficient and remunerative output.

51 We look particularly to Government to ensure, by way of example and for its profit, that its own maintenance practice is sound. The public sector of construction is large enough to influence the remainder in any direction desired. The Ministry of Public Building and Works has made facilities available to us for practical assessment of some ideas discussed in this Report. This is an important safeguard of which we hope to make increasing use. We welcome also the scope afforded the industry to develop rationalised techniques for use in the programme of housing renovation announced in the White Paper *Old Houses into New Homes* (Cmnd. 3602). Measures such as these are favourable to a change in the social climate of maintenance such as we seek to bring about.

52 The following is a summary of our principal recommendations to the Minister of Public Building and Works:

(1) A study should be made of the economic significance of maintenance. (Para. 13.)

(2) The Ministry should undertake a review of the operation of capital cost limits in relation to subsequent running costs. (Para. 17.)

(3) The Construction Industry Training Board should be encouraged to enlist the support of the industry in developing the study of maintenance management. (Para. 19.)

(4) The Government should review with the construction industry the periods of liability arising from design commissions and contracts for works and building supplies. (Para. 21.)

(5) The Ministry should examine the commercial prospects of a national testing and advisory service for the construction industry. (Para. 23.)

(6) In the event of a Maintenance Cost Information Service proving feasible, early consideration should be given to arranging for its provision. (Para. 24.)

(7) Centres of research should be established for the study of operational aspects of building maintenance. (Paras. 34 and 42.)

(signed) Winterbottom
C. E. Bedford
E. F. L. Brech
H. E. Buteux
E. D. France
E. Hollamby
M. V. Jarman
T. W. Parker
K. J. Pearce
W. J. Reiners
D. A. Turin
J. C. Weston
A. C. Wheeler

APPENDIX

Further Papers on Building Maintenance

Papers on the following subjects are in preparation:

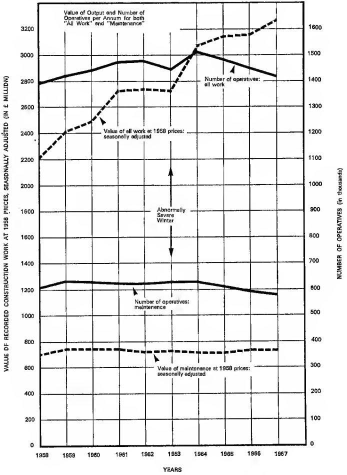
- Studies of Maintenance Undertakings
- Studies of Property Management
- Maintenance Manuals
- Maintenance Technology
- Maintenance Data Classification Systems
- Cost in Use
- Labour Incentive Schemes
- Conference Reports—Edinburgh and Manchester (1966)
  London (Profitable Building Maintenance 1967)
  Bath (Maintenance Technology 1968)

Details of these publications are available from:

Building Information Room,
Ministry of Public Building and Works,
Room 1312,
Thames House South,
Millbank,
London, S.W.1.
01-834 9020; Ext. 1725.

Construction Trends

GRAPH A

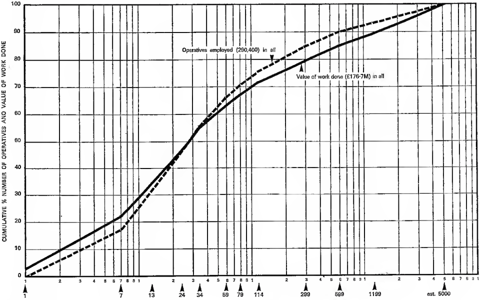


Distribution of Maintenance Work by Size of Firm

GRAPH B

shown as cumulative % numbers of operatives and value of work done

For 1st Quarter 1967

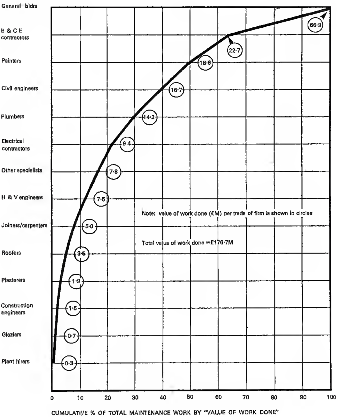


GRAPH C

Distribution of Maintenance Work by Trade of Firm

shown as cumulative % of value of work done

For 1st Quarter 1967



Note: value of work done (£M) per trade of firm is shown in circles

Total value of work done =£176·7M

Printed in England for Her Majesty's Stationery Office by Verstage Bros. Ltd., Basingstoke.

(L1205) Dd 147143 K24 12/68 V.B. Gp 433

Ministry of Public Building and Works
Directorate of Research and Information

Building Maintenance

**The Interim Report of a Committee appointed by
The Minister of Public Building and Works**

LONDON: Her Majesty's Stationery Office
1969

SBN 11 670214 1

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